Investigation of Air Permeability of Handwoven Fabrics

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Handwoven fabrics, which made with cotton and silk, have unique characteristics and feel and are being produced in many parts of Thailand for making handicrafts such as pieces of clothing, embellishments, and home furnishings. It should be one of the largest income sources for many Thailand people, especially in rural areas (Fujioka, 2002). In general, handwoven fabrics are not woven as tightly and strongly as machine-produced woven fabrics, resulting in fraying and shifting fabric shape easily during the construction process. To solve this weakness, fusible polyester interfacing liner tends to be ironed onto the back of handwoven cotton and silk before cutting and sewing since it makes the handwoven fabric stiffer and keeps its shape. It results producers can cut handwoven cotton and silk easily and sew them with fabric less-distorted. However, it also affects the thickening of the fabric, resulting negatively to breathability and ability to transfer heat and humid between wearer body and an inner layer of clothing. Thailand locates in the tropics, which is hot and humid across the nation. This research began with the question if adding layers, like fusible interfacing liner, is appropriate in a hot and humid climate and why this technique has used for a while in Thailand. Limited studies have examined the thermal comfort of multi-layer fabrics, especially with fusible interfacing liner (Shabaridharan, 2012). Therefore, the purpose of this study to investigate if the use of fusible interfacing liner is appropriate and how it affects the thermal comfort of the wearer by measuring air permeability in handwoven cotton and silk.

The air permeability, the degree of air in milliliters that is passed in one second through the material, is a very important consideration in the performance of fabrics. Air permeability helps with transporting heat and wetness from the skin to the surface setting (Ogulata, 2006). Previous research has presented that air permeability mainly dependents upon the fabric's weight and thickness. Air permeability decreases when fabric thickness increase. Also, lightweight fabrics create better air permeability.

Three different 100% handwoven cotton fabrics (CO) and six different 100% handwoven silk fabrics (SL), which are used popularly in Thailand, were selected as the surface fabrics and tested in two different conditions; 1) fabric only (FO) and 2) fabric with 100% polyester fusible interfacing liner (FFIL). The fusible interfacing liner was ironed onto the back of each of handwoven fabric specimen. To measure fabric thickness, AMES Digital Thickness Tester (model: BG1110-1-04) were used with the test standard ASTM-D1777. For fabric weight measurement, all fabric specimens were cut 5 inches in length by 5 inches in width. According to ASTM D3776/D3776M standards, a specimen should have a minimum of 20 square inch area. Fabric specimens were weighed by the Mettler Toledo weighing scale. Finally, to measure the air permeability, The TEXTEST Air Permeability Tester (model: FX 3300 LabAir IV) was used with the test standard ASTM D737-04. The specimen was placed under the test head and it was confirmed that there was no wrinkle.

All measurements were repeated five times for each specimen and the average value of the variables was presented in Table 1. As shown in Table 1 with a descriptive analysis, though adding fusible interfacing liner, fabric thicknesses of handwoven cotton and silk have increased by about 11% to

133% from the thickness of fabric only (FO) samples and on average it increased by about 68.8%. The weight of fabrics with fusible interfacing liner (FFIL) have also increased by about 13% to 56% from the weight of FO and it averagely increased by 39.7%. However, air permeability has decreased by 27.4% averagely by adding the fusible interfacing liner. These results are consistent with previous research findings that fabric air permeability exhibits a decreasing trend with the increase in fabric thickness and weight.

Table 1. Measurements of Thickness, Weight, and Air Permeability

	Fabric only (FO)			Fabric + Fusible Interfacing Liner (FFIL)		
	Thickness	Weight	Air permeability	Thickness	Weight	Air permeability
CO1	0.050	177.56	149.60	0.057 (+14%)	214.88 (+21%)	97.54 (-35%)
CO2	0.063	239.39	72.96	0.070 (+11%)	272.77 (+13%)	55.06 (-25%)
CO3	0.024	129.96	104.46	0.034 (+42%	173.65 (+33%)	76.80 (-26%)
SL1	0.009	69.85	31.82	0.019 (+111%)	106.99 (+53%)	28.26 (-11%)
SL2	0.010	94.89	6.93	0.021 (+110%)	140.88 (+48%)	4.22 (-39%)
SL3	0.009	84.35	17.38	0.020 (+122%)	123.26 (+46%)	13.10 (-25%)
SL4	0.009	96.06	17.14	0.021 (+133%)	138.83 (+44%)	11.32 (-34%)
SL5	0.019	98.04	57.42	0.029 (+53%)	137.60 (+40%)	43.22 (-25%)
SL6	0.025	78.85	97.08	0.031 (+24%)	123.34 (+56%)	70.60 (-27%)

The regression analysis by Statistical Package for the Social Sciences (SPSS) software was employed to examine the correlation between each independent variable and the dependent variable. Table 2 presents that fabric thickness significantly influence to air permeability ($F(1, 24) = 13.341$, $p < .0012$), but fabric weight is a not statistically significant factor to air permeability of handwoven cotton and silk fabrics used in Thailand ($F(1, 24) = 4.232$, $p < .0506$). However, since the p-value slightly greater than 0.05, it should be close to being statistically significant. Thus, both factors hold significant importance in predicting the air permeability of handwoven fabrics and showed negative relations with air permeability.

Table 2. Correlation between Fabric Thickness & Weight and Air Permeability

		df	*SS*	*MS*	*F*	*P value*
Thickness	Regression	1	10136.57	10136.57	13.341	0.0012**
	Residual	24	18234.85	759.7853		
	Total	25	28371.41			
Weight	Regression	1	4252.96	4252.96	4.232	0.0506
	Residual	24	24118.45	1004.936		
	Total	25	28371.41			

The finding of air permeability presents that adding layers increase fabric thickness and weight which negatively influence to air permeability decreased. Thus, the handwoven fabrics with fusible interfacing liner have lower air permeability than the fabric only do. However, the decrease in air permeability is not as large as the increase in fabric thickness and weight. It could be a reason to continue to use the handwoven fabrics with fusible interfacing liner at the risk of lower air permeability. Finally,

this research contributes to prove that fabric thickness and weight are significant factors to air permeability of handwoven fabrics used popularly in Thailand.

References

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